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Effects of Tohoku Tsunami and Fukushima Radiation on the U.S. Marine Environment

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Summary

The massive Tohoku earthquake and tsunami of March 11, 2011, caused extensive damage in northeastern Japan, including damage to the Fukushima Dai-ichi nuclear power installation, which resulted in the release of radiation. Some have called this incident the biggest manmade release ever of radioactive material into the oceans. Concerns arose about the potential effects of this released radiation on the U.S. marine environment and resources.

Both ocean currents and atmospheric winds have the potential to transport radiation over and into marine waters under U.S. jurisdiction. It is unknown whether marine organisms that migrate through or near Japanese waters to locations where they might subsequently be harvested by U.S. fishermen (possibly some albacore tuna or salmon in the North Pacific) might have been exposed to radiation in or near Japanese waters, or might have consumed prey with accumulated radioactive contaminants.

High levels of radioactive iodine-131 (with a half-life of about 8 days), cesium-137 (with a half-life of about 30 years), and cesium-134 (with a half-life of about 2 years) were measured in seawater adjacent to the Fukushima Dai-ichi site after the March 2011 events. EPA rainfall monitors in California, Idaho, and Minnesota detected trace amounts of radioactive iodine, cesium, and tellurium consistent with the Japanese nuclear incident, at concentrations below any level of concern. It is uncertain how precipitation of radioactive elements from the atmosphere may have affected radiation levels in the marine environment.

Scientists have stated that radiation in the ocean very quickly becomes diluted and would not be a problem beyond the coast of Japan. The same is true of radiation carried by winds. Barring another unanticipated release, radioactive contaminants from Fukushima Dai-ichi should be sufficiently dispersed over time that they will not prove to be a serious health threat elsewhere, unless they bioaccumulate in migratory fish or find their way directly to another part of the world through food or other commercial products.

Radioactive contamination of seafood from the nuclear disaster in Japan has not emerged as a food safety problem for consumers in the United States. According to the U.S. Food and Drug Administration (FDA), the damage to infrastructure in Japan limited food production and associated exports from areas near the Fukushima nuclear facility. FDA and Customs and Border Protection continue to screen imported foods from Japan, including seafood, before they can enter the U.S. food supply.

Based on computer modeling of ocean currents, marine debris from the tsunami produced by the Tohoku earthquake was projected to spread eastward from Japan in the North Pacific Subtropical Gyre. Approximately two to three years after the event, the debris plume was projected to reach the U.S. West Coast, dumping debris on California beaches and the beaches of British Columbia, Alaska, and Baja California. However, initial debris is already arriving. Although most of the radioactive release from Fukushima Dai-ichi is believed to have occurred after the tsunami, there is a slight possibility that some of the tsunami debris might also be contaminated with radiation. A related concern is the transport of nonnative, and potentially invasive, species from Japan to U.S. shores on marine debris. Legislation (H.R. 1171, H.R. 6251, and S. 1119) has been introduced in the 112th Congress to address marine debris concerns.

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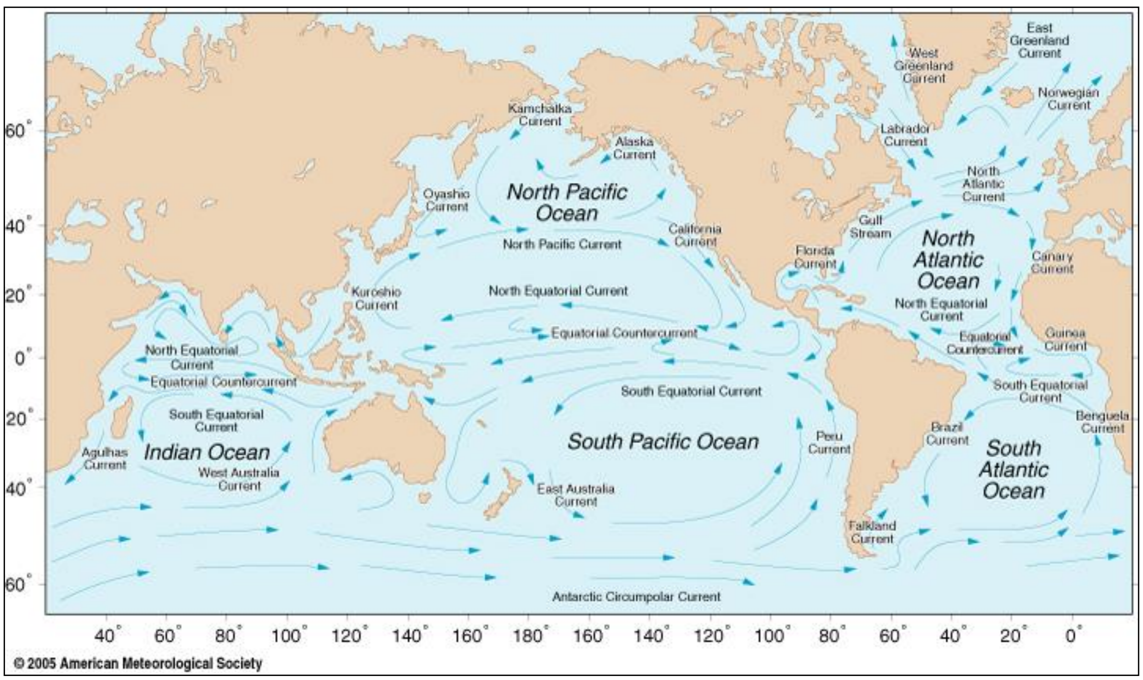
Background

The massive Tohoku earthquake and tsunami of March 11, 2011, caused extensive damage in northeastern Japan, including damage to the Fukushima Dai-ichi nuclear power installation, which resulted in the release of radiation.[1] Some have called this incident the biggest manmade release ever of radioactive material into the oceans.[2] Concerns arose about the potential effects of this released radiation on the U.S. marine environment and resources.

The North Pacific Current is formed by the collision of the Kuroshio Current, running northward off the east coast of Japan in the eastern North Pacific, and the Oyashio Current, running southward from Russia (**Figure 1**). As it approaches the west coast of North America, the North Pacific Current splits into the southward California Current and the northward Alaska Current. Although these currents have the potential for bringing radiation from Japan's Fukushima Dai-ichi nuclear accident to U.S. waters, their flow is slow, and no radiation above background levels has yet been detected in marine waters under U.S. jurisdiction. Regardless of the slow flow, radioactive contaminants with long half-lives (e.g., cesium-137, with a half-life of about 30 years) could still pose concerns if transported over long distances by ocean currents.

Figure 1. Ocean Currents



Source: American Meteorological Society.

Seawater was monitored by the Tokyo Electric Power Company (TEPCO) near the discharge points of the Fukushima Dai-ichi plant following the March 2011 events. Water with a dose rate of greater than 1,000 millisievert per hour was confirmed by TEPCO on April 2, 2011, in a pit located next to Fukushima Dai-ichi's Unit 2 seawater inlet point. A cracked sidewall of this pit

[1] For additional background on this incident, see CRS Report R41694, *Fukushima Nuclear Disaster*, by Mark Holt, Richard J. Campbell, and Mary Beth Nikitin.

[2] Quirin Schiermeier, "Radiation Release Will Hit Marine Life," *Nature*, v. 472 (April 12, 2011): 145-146.

was leaking water from the pit directly into the ocean.[3] Analyses of seawater taken from near the discharge from Fukushima Dai-ichi Units 1-4 yielded readings of 130,000 Becquerels/liter (Bq/l) of iodine-131 (half-life of about 8 days), 32,000 Bq/l of cesium-137 (half-life of about 30 years), and 31,000 Bq/l of cesium-134 (half-life of about 2 years).[4] Although the leak in the cracked sidewall was stopped after several days,[5] the total amount of radioactive contaminants that entered the ocean was unknown, and discharges, both accidental and deliberate,[6] continued for several weeks.[7] Radioisotope concentrations at offshore sampling points decreased with time; by early April 2011, at sampling points about 30 km east of Fukushima Dai-ichi, concentrations were between 5 and 18 Bq/l for iodine-131 and between 1 and 11 Bq/l for cesium-137. The highest concentrations, found closest to the coast, were about 38 Bq/l for iodine-131 and 4.5 Bq/l for cesium-137.[8] The occurrence of cesium-137 is of greater concern because of its much longer half-life. The natural radioactivity of seawater is 13 or 14 Bq/l, of which 95% comes from potassium-40.[9] Experts cite this incident as the largest recorded accidental release of radiation to the ocean.[10]

Atmospheric transport (i.e., wind) also is capable of transporting radiation eastward, where it may settle or precipitate into U.S. marine waters (**Figure 2**).[11] The U.S. Department of Energy and the U.S. Environmental Protection Agency (EPA) monitor atmospheric radiation. In early April 2011, EPA monitors in California, Idaho, and Minnesota detected trace amounts of radioactive iodine, cesium, and tellurium in rainwater, consistent with the Japanese nuclear incident; to date, concentrations have been far below any level of concern.[12] One study estimated a total atmospheric release of 35.8 petabecquerels of cesium-137, with the highest release from March 12 to 19 and about 79% of subsequent deposition over the North Pacific Ocean.[13]

It is unknown whether marine organisms that migrated through or near Japanese waters to locations where they might subsequently be harvested by U.S. fishermen (possibly some tuna or salmon in the North Pacific) might have been exposed to radiation in or near Japanese waters, or might have consumed prey that had accumulated radioactive contaminants. Two minke whales harvested by Japanese whalers off the coast of Hokkaido in May 2011 were found to have slightly

[3] Fukushima Nuclear Accident Update Log (April 2, 2011), at http://www.iaea.org/newscenter/news/2011/fukushima020411.html.

[4] Fukushima Nuclear Accident Update Log (March 31, 2011), at http://www.iaea.org/newscenter/news/2011/fukushima310311.html.

[5] Fukushima Nuclear Accident Update Log (April 6, 2011), at http://www.iaea.org/newscenter/news/2011/fukushima060411.html.

[6] Water with comparatively lower radioactive contamination is being discharged to the sea to provide room at and near Fukushima Dai-ichi to store water with higher levels of radioactivity in a safer manner.

[7] Quirin Schiermeier, "Radiation Release Will Hit Marine Life," *Nature*, v. 472 (April 12, 2011): 145-146.

[8] Fukushima Nuclear Accident Update Log (April 5), at http://www.iaea.org/newscenter/news/2011/fukushima050411.html.

[9] Idaho State University, *Radioactivity in Nature*, at http://fizisist.web.cern.ch/fizisist/funny/NaturalRadioactivity.pdf.

[10] Ken Buesseler, Michio Aoyama, and Masao Fukasawa, "Impacts of the Fukushima Nuclear Power Plants on Marine Radioactivity," *Environmental Science & Technology*, v. 45 (December 1, 2011): 9931-9935.

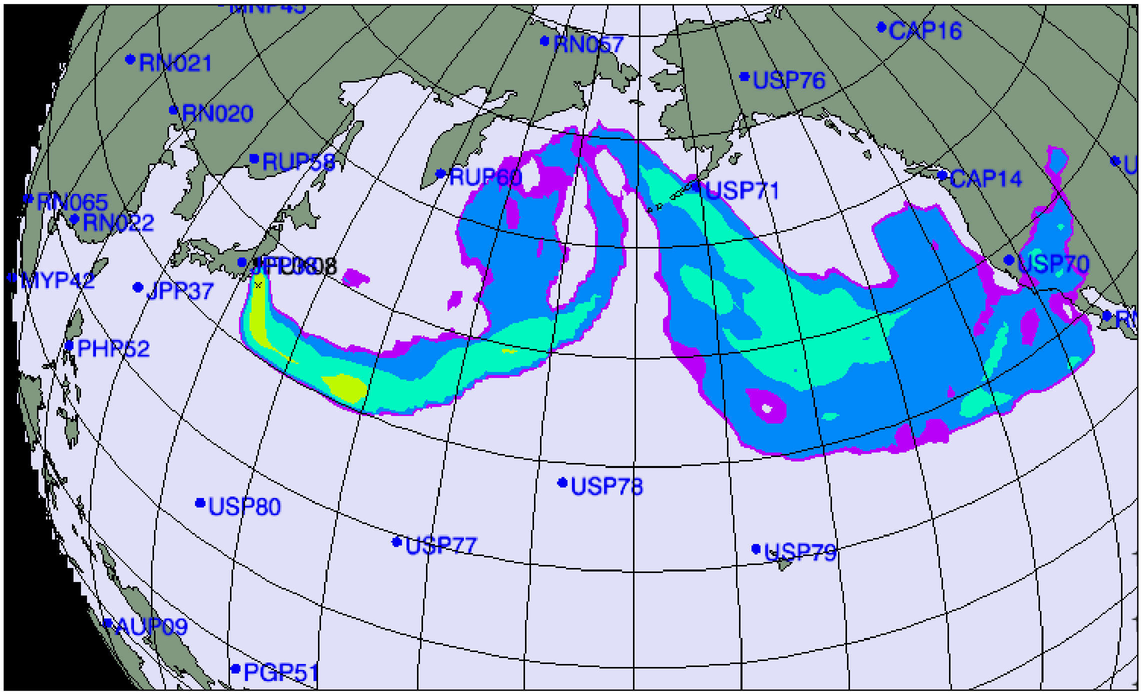
[11] Other projections of atmospheric trajectories can be found at http://www.atmos.umd.edu/~tcanty/hysplit/.

[12] See http://www.epa.gov/radiation/data-updates.html; also see http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/3724de8571e1b03f8525785c00041a7a%21OpenDocument.

[13] Andreas Stohl, et al. "Xenon-133 and Caesium-137 Releases into the Atmosphere from the Fulushima Dai-ichi Nuclear Power Plant: Determination of the Source Term, Atmospheric Dispersion, and Deposition," *Atmospheric Chemistry and Physics Discussion*, v. 11, no. 10 (2011): 2819-394.

elevated radioactive cesium-137 levels.[14] In August 2011, bluefin tuna off the coast of California were found to have slightly elevated levels of cesium-137 and cesium-134.[15]

Figure 2. Atmospheric Radiation Forecast for March 18, 2011



Source: Comprehensive Nuclear Test Ban Treaty Organization, Vienna, Austria.

Notes: This forecast shows how weather patterns might be expected disperse radiation from a continuous source in Fukushima, Japan. *The forecast does not show actual levels of radiation.* The colors correspond to the projected intensity of radiation, with yellow being most intense and progressing to less intensity through the green, blue, to violet end of the spectrum.

A British scientist reportedly stated that, "given the scale of the Pacific—the world's vastest body of water—radioactivity in the sea at Fukushima will be flushed out beyond the local area by tides and currents and dilute to very low levels. It [radioactive contamination] will get into the (ocean) food chain but only in that vicinity. Should people in Hawaii and California be concerned? The answer is no."[16] Although not at harmful levels, significant radiation from cesium-137 was reported to be detected 400 miles offshore of Japan three months after the tsunami.[17] There is also the possibility that there could be bioaccumulation of longer-half-life radioactive elements by fish whose migratory habits subsequently may take them far from Japanese waters.

Scientists at the Woods Hole Oceanographic Institution advised that radiation levels in seafood should continue to be monitored, but stated that radiation in the ocean very quickly becomes diluted and should not be a problem beyond the coast of Japan. The same is true of radiation carried by winds around the globe. Radioactive contaminants from Fukushima appear to have

[14] Mary Yamaguchi, *Traces of Radiation Found in 2 Whales Off Japan*, Associated Press, June 15, 2011.

[15] Daniel J. Madigan, et al., "Pacific Bluefin Tuna Transport Fukushima-Derived Radionuclides from Japan to California," *Proceedings of the National Academy of Sciences*, v. 109, no. 24 (June 12, 2012): 9483-9486.

[16] Simon Boxall, a lecturer at Britain's National Oceanography Centre at the University of Southampton, England, quoted in http://news.discovery.com/earth/japan-seafood-110330.html.

[17] See http://www.eenews.net/Greenwire/print/2012/02/22/24.

become sufficiently dispersed over time that they will not prove to be a serious health threat elsewhere, unless they bioaccumulate in migratory fish or find their way directly to another part of the world through food or other commercial products.[18] However, there remains the slight potential for a relatively narrow corridor of highly contaminated water leading away from Japan and a very patchy distribution of contaminated fish—extensive monitoring will determine the exact dispersion of these radioactive contaminants.

Concerns

Are There Implications for U.S. Seafood Safety?

It does not appear that nuclear contamination of seafood will be a food safety problem for consumers in the United States.[19] Among the main reasons are that

- damage from the disaster limited seafood production in the affected areas,
- radioactive material would be diluted before reaching U.S. fishing grounds, and
- seafood imports from Japan are being examined before entry into the United States.

According to the U.S. Food and Drug Administration (FDA), because of damage from the earthquake and tsunami to infrastructure, few if any food products were being exported from the affected region.[20] For example, according to the National Federation of Fisheries Cooperative Associations, the region's fishing industry stopped landing and selling fish.[21] Furthermore, a fishing ban has been enforced within a 2-kilometer radius around the damaged nuclear facility.[22]

U.S. fisheries are unlikely to have been affected because radioactive material that entered the marine environment would be greatly diluted before reaching U.S. fishing grounds. However, some have advocated vigilance, especially for seafood from areas near the damaged nuclear facility. It has been suggested that cesium-137 could move up the food chain and become concentrated in fish muscle or that radiation hot spots could occur.[23] Another potential concern is related to accumulation of strontium-90 in fish bone, because its chemical properties are similar to those of calcium.[24] Radioactive contaminants have been collecting in sediments in coastal areas near the damaged nuclear facility and exposing bottom-dwelling fish, shellfish, and other organisms to relatively high contaminant levels.[25] The Japanese Ministry of Health, Labor, and

[18] See http://www.whoi.edu/page.do?pid=56076&tid=282&cid=94989.

[19] For additional information, see U.S. Environmental Protection Agency, U.S. Food and Drug Administration, and National Oceanic and Atmospheric Administration, *U.S. Seafood Safe and Unaffected by Radiation Contamination from Japanese Nuclear Power Plant Incident; U.S. Monitoring Control Strategy Explained*, available at http://www.nmfs.noaa.gov/mediacenter/docs/2011/may/seafoodsafetyfactsheet_03may2011.pdf.

[20] U.S. Dept. of Health and Human Services, Food and Drug Administration, *Radiation Safety*, March 29, 2011, http://www.fda.gov/newsevents/publichealthfocus/ucm247403.htm.

[21] "Tsukiji wholesaler thinks it may take a year for the market to stabilize," *Reuters*, March 23, 2011.

[22] Prachi Patel, "Fukushima's Impact on the Ocean Analyzed," *IEEE Spectrum*, Inside Technology, January 2012, http://spectrum.ieee.org/energy/environment/fukushimas-impact-on-the-ocean-analyzed.

[23] Elizabeth Rosethal, "Radiation, Once Free, Can Follow a Tricky Path," *New York Times*, March 21, 2011.

[24] The threat from strontium-90 would be greater if fish bones were consumed in products such as some types of canned fish and small fish eaten whole.

[25] Ken Buesseler, "What Fukushima accident did to the ocean," *CNN*, March 11, 2012, pp. http://www.cnn.com/2012/03/10/opinion/buesseler-fukushima-ocean/index.html?hpt=hp_bn9.

Welfare has reported fish samples from Fukushima prefecture that are above the provisional regulation values for cesium-134 and cesium-137.[26] Contaminated fish samples have included greenling, several types of flounder, common skate, rock fish, Japanese seabass, and brown hakeling.[27]

The most common foods imported from Japan include seafood, snack foods, and processed fruits and vegetables. In 2011, the United States imported 40.1 million pounds of seafood from Japan with a value of $268.3 million.[28] The FDA has primary responsibility for the safety of all domestic and imported seafood, under the Federal Food, Drug, and Cosmetic Act (FFDCA), as amended (21 U.S.C. §301 et seq.). The FFDCA requires that all foods be safe, wholesome, and accurately labeled. FDA's general approach to ensuring the safety of seafood imports is based on identifying risks from the production process, from specific types of seafood, and from certain countries or firms.

On March 22, 2011, FDA issued an import alert for food products from four Japanese prefectures. The alert has been updated periodically since then to reflect changing conditions with regard to food items and areas (prefectures) covered. FDA's import tracking system is being used to identify all shipments of FDA-regulated products from Japan, with special attention to shipments from companies within the affected area. As of March 2012, FDA field examinations and tests of food products had not found any radionuclide contamination above the established derived intervention level.[29] FDA has divided all food products from Japan into the following four categories.

> Category 1—Products that are not allowed entry to the United States. Consists of products that the government of Japan has restricted for sale or export.
>
> Category 2—Products that may be detained under Import Alert 99-33[30] and may be released if the importer can show the products are safe. Consists of products from Fukushima, Ibaraki, and Tochigi Prefectures that the Government of Japan has not banned from sale or export.
>
> Category 3—Products from Fukushima, Ibaraki, and Tochigi Prefectures that are not covered by the FDA's import alert. These products are examined and may be sampled and tested as needed.
>
> Category 4—All other FDA-regulated food products from Japan that are not listed on the import alert and not included in the other three categories. These products are monitored by standard procedures.

The only seafood item included on the import alert is sand lance (a small fish) from Fukushima Prefecture, which is also listed under Category 1 and is not allowed entry to the United States.

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[26] International Atomic Energy Agency, *IAEA Fukushima Daiichi Status Report*, February 23, 2012, http://www.iaea.org/newscenter/focus/fukushima/statusreports/fukushima23_02_12.html.

[27] For most samples of foodstuffs (over 99%) from 46 different prefectures, radioactive cesium levels were undetectable or below the regulation values set by Japanese authorities.

[28] U.S. Dept. of Commerce, National Marine Fisheries Service, Fisheries Statistics and Economics Division, "U.S. Foreign Trade Query," March 30, 2012, http://www.st.nmfs.noaa.gov/st1/trade/index.html.

[29] Food and Drug Administration, *Radiation Safety*, New and Updated Information, March 29, 2012, http://www.fda.gov/newsevents/publichealthfocus/ucm247403.htm#sofar.

[30] Items on FDA import alerts are detained without physical examination and only released if the importer can show the product is safe. Import Alert 99-33 includes items in Category I, which are not allowed entry, and may include items from Category 2.

How Likely Is It That Radiation Will Reach U.S. Marine Waters, Through Either Ocean Currents or Atmospheric Transport?

Since radiation has been detected reaching various U.S. locations by atmospheric transport, rainfall is likely to already have introduced radioactive elements from the Fukushima Dai-ichi accident into U.S. marine waters. Transport by ocean currents is much slower, and additional radiation from this source might eventually also be detected in North Pacific waters under U.S. jurisdiction, even months after its release. Regardless of slow ocean transport, the long half-life of radioactive cesium isotopes means that radioactive contaminants could remain a valid concern for years.

What Are the Likely Responses If Radiation Is Detected?

If only low levels of radiation are detected, continued monitoring of the situation will be the likely response. In the unlikely event that higher levels of radiation are detected, measures (e.g., removal of contaminated products from commerce) are to be taken to prevent or minimize human exposure to the contaminated media.

For background information on radiation and its potential for harm, see CRS Report R41728, *The Japanese Nuclear Incident: Technical Aspects*, by Jonathan Medalia.

What Are Other Possible Effects of the Tohoku Earthquake and Tsunami on the U.S. Marine Environment?

Debris

Based on computer modeling of ocean currents, debris from the tsunami produced by the Tohoku earthquake of March 11, 2011, was projected to spread eastward from Japan in the North Pacific Subtropical Gyre. Initial models suggested that in a year, debris would reach the Northwestern Hawaiian Islands Marine National Monument; in two years, the remaining Hawaiian islands could see this debris; in three years, the debris plume likely would reach the U.S. west coast, dumping debris on California beaches and the beaches of British Columbia, Alaska, and Baja California.[31] An animation of the projected movement of the marine debris is available at http://iprc.soest.hawaii.edu/users/nikolai/2011/Pacific_Islands/Simulation_of_Debris_from_March_11_2011_Japan_tsunami.gif. Although much of the radioactive release from Fukushima Dai-ichi is believed to have occurred after the tsunami, there is the possibility that some of the tsunami debris might have been contaminated with radiation from Fukushima Dai-ichi.

More recent observations indicate that some debris could be traveling faster than predicted.[32] Although much of the debris sank quickly, the initial debris field was estimated to contain possibly 1.5 million tons of debris and to be approximately 3,700 kilometers long and 1,800 kilometers wide.[33] Subsequently, the debris has become widely dispersed as it moved further

[31] Press release from the International Pacific Research Center (IPRC) of the School of Ocean and Earth Science and Technology (SOEST) at the University of Hawaii at Manoa, available at http://www.sciencedaily.com/releases/2011/04/110406102203.htm?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+sciencedaily+(ScienceDaily%3A+Latest+Science+News).

[32] See http://marinedebris.noaa.gov/info/images/gnomegraphic.jpg.

[33] Steve Herman, "Tsunami Debris Could Hit Mid-Pacific Island Soon," November 22, 2011; available at

offshore, and a coherent debris field is no longer apparent. In mid-November 2011, Canadian ocean modelers predicted that initial debris from the Tohoku earthquake and tsunami, especially large debris more subject to wind effects, would soon begin appearing on Pacific Northwest beaches.[34] Fishing vessels and other large pieces of debris could pose hazards to navigation. Items that some believe might have been initial debris from the tsunami began to be reported on Pacific Northwest beaches in early December 2011.[35] A derelict 150-foot Japanese fishing vessel, spotted off the British Columbia coast in March 2012, was sunk by the U.S. Coast Guard as a hazard to navigation.[36] A 165-ton dock grounded on an Oregon beach in early June 2012.[37] The majority of the debris is still not anticipated to reach U.S. shores before 2013.

In light of concerns about arriving debris, Members of Congress requested additional action from the Administration.[38] A joint federal-state-provincial tsunami debris information center has been established to coordinate planning on how to manage arriving debris.[39] In addition, NOAA has established a website to coordinate efforts to deal with the debris[40] and requests that reports of significant debris sightings be e-mailed to disasterdebris@noaa.gov for compilation.[41] Maps of reported tsunami debris are available at http://marinedebris.noaa.gov/tsunamidebris/debris_sightings.html. NOAA has announced $250,000 in grant funds available to five Pacific coastal states for debris removal activities.[42] Legislation in the 112th Congress (H.R. 1171, H.R. 6251, and S. 1119) to reauthorize the Marine Debris Research, Prevention, and Reduction Act (33 U.S.C. 1951 et seq.) may promote a discussion of how this program might be modified to better deal with emergency issues such as tsunami debris.[43]

Invasive Species

The 188-ton dock that grounded on an Oregon beach in early June 2012 was encrusted with marine life from Japan, presenting the potential for invasive species becoming established. Marine life noted on this dock include more than 90 species of barnacles, starfish, urchins,

http://www.voanews.com/english/news/asia/east-pacific/Tsunami-Debris-Could-Hit-Mid-Pacific-Island-Soon-134312748.html.

[34] Yasmin Aboelsaud, "Japanese Tsunami Debris Could Soon Reach Local Coastline," November 17, 2011; available at http://www.canada.com/story_print.html?id=5723823.

[35] "Flotsam from Japanese Tsunami Reaches West Coast; Wind Pushes Drum-Size Debris to Wash. Beach," *Washington Post*, December 15, 2011; Dennis Ryan, "Debris from Japan Tsunami Washes Up on B.C. Shores," *Vancouver Sun*, December 29, 2011.

[36] See http://news.nationalpost.com/2012/03/24/japanese-fishing-boat-lost-in-tsunami-nears-b-c-coast/ and http://in.reuters.com/assets/print?aid=INDEE83500W20120406.

[37] See http://earthfix.opb.org/water/article/tsunami-debris-environmental-threat-invasive-speci/.

[38] For example, see http://www.cantwell.senate.gov/news/033012_Cantwell_Begich_Tsumani_Debris_Letter_to_the_President.pdf.

[39] See http://disasterdebris.wordpress.com/about/.

[40] See http://marinedebris.noaa.gov/tsunamidebris/.

[41] For additional information, see http://marinedebris.noaa.gov/info/japanfaqs.html.

[42] Announcement available at http://disasterdebris.wordpress.com/2012/07/16/noaa-debris-removal-grant/.

[43] On April 25, 2012, the Senate Committee on Commerce, Science, and Transportation reported (amended) S. 1119 (S.Rept. 112-161), including language that would authorize the development of interagency action plans and research to bolster preparedness for severe marine debris events, such as those caused by a tsunami or other natural disaster. On December 15, 2011, the House Natural Resources Subcommittee on Fisheries, Wildlife, Oceans, and Insular Affairs held a hearing on H.R. 1171. On July 9, 2012, the House Committee on Natural Resources reported (amended) H.R. 1171 (H.Rept. 112-584, Part I); and on July 17, 2012, the House Committee on Transportation and Infrastructure reported (amended) this bill (H.Rept. 112-584, Part II). On August 1, 2012, the House passed H.R. 1171, amended.

anemones, amphipods, worms, mussels, limpets, snails, tunicates, sponges, and algae.[44] Most marine debris lacks the dense fouling communities of marine life that occurred on this dock. Volunteers removed about 1.5 tons of marine life from the dock and buried this material above high tide and storm surge.[45] The dock was then cleansed with flames to sterilize the surface. This is one of three similar docks that were dislodged by the tsunami at Misawa, Japan, and had not been accounted for.

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Disclaimer

[44] For an accounting of species found, see http://blogs.oregonstate.edu/floatingdock/.

[45] See http://www.kgw.com/home/Biologists-to-scrape-marine-life-off-tsunami-barge-157796925.html.